Making a market for Miscanthus: can new contract designs solve the biofuel investment hold-up problem?

Steven Y. Wu*, Stephanie Rosch¹*, Corinne E. Alexander*, Wallace E. Tyner*, Joshua Yoder*

*Department of Agricultural Economics, Purdue University
403 West State Street, West Lafayette, IN 47906

¹ Corresponding author: srosch@purdue.edu, Ph: (765) 496-7318


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Abstract
We present designs for optimal contracts to solve the investment hold-up problem for perennial crops for the biofuel industry. A fixed-price contract is ex-ante efficient but renegotiation-proof for a limited range of discount parameters. A perfectly-indexed contract is both renegotiation proof and ex post efficient. Provided long-run land prices are stationary, the expected cost for both contracts converges to the long-run expected price of land for a risk-neutral farmer.

Motivation
- Biofuels, such as ethanol or biodiesel, have traditionally been manufactured from annual crops such as corn or sugar. The environmental benefits of these crop sources is questionable (Schlarlemann & Laurance 2008) and diverting food crops from human consumption can have real impacts on domestic food prices (Abbott et al. 2008)
- The technology exists to manufacture biofuels from perennial crops such as switchgrass, Miscanthus, or willow. None of these crops are presently grown at commercial scale, however, and the investment cost of a plant to process these feedstocks is much greater than for a conventional corn-fueled plant. This leads to an investment hold-up problem: firms are unwilling to commit resources to build a refinery to process perennial crops without first insuring an adequate supply of feedstocks.
- Long-term contracts between farmers and processors are one possible solution to the investment hold-up problem. In the absence of a traded market, these contracts would establish (1) a price for the contracted good and (2) a range of discount parameters. A perfectly-indexed contract provides complete insurance against absolute earnings losses, but does not insurance against relative earnings losses. Relative earnings losses are instances where profit under the fixed price contract is less than the realized profit for the outside option. Fixed price contracts also protect the agent against the risk of principal bankruptcy, as the principal’s future liabilities are well-specified ex-ante. The other hand, the perfect index completely insures the agent against relative earnings losses, but does not protect against principal bankruptcy or absolute earnings losses.

Ex-Post Efficient Contract
- Since there is no existing market for these crops, one strategy that is likely to be agreeable to both contracting parties is to construct an index from familiar commodities (such as corn, wheat, hay, oil, diesel, etc). The indexed contract uses a consistent relationship between changes in the index price and changes in the contract price over the full contract period such that the contract price always reflects the value of the contracted good contingent on the realized state of the world.
- A perfect index – where changes in the index price are completely reflected in the contract price without attenuation or amplification – maximizes ex-post realized surplus.

Ex-Ante Efficient Contract
- For risk averse agents, the contract price which maximizes ex-ante expected surplus is a fixed price contract.

Conclusions
- A fixed-price contract is ex-ante efficient but renegotiation-proof for a limited range of discount parameters. A perfectly-indexed contract is both renegotiation-proof and ex post efficient. Provided long-run land prices are stationary, the expected cost for both contracts converges to the long-run expected price of land for a risk-neutral farmer.
- The fixed price contract provides complete insurance against absolute earnings losses, but no insurance against relative earnings losses. Relative earnings losses are instances where profit under the fixed price contract is less than the realized profit for the outside option. Fixed price contracts also protect the agent against the risk of principal bankruptcy, as the principal’s future liabilities are well-specified ex-ante. On the other hand, the perfect index completely insures the agent against relative earnings losses, but does not protect against principal bankruptcy or absolute earnings losses.
- An agent is indifferent between these two contracts if and only if the realized index price exactly equals expected index price less the idiosyncratic risk premium. With heterogeneous agents, there will be some set of agents who are not indifferent between these contracts for any given ex-post index price, depending on the frequency of agent types in the population.

References